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(54) **Seed treatment composition**

(57) An aqueous film forming seed treatment composition comprising

a. 5-50 wt.-% of a film forming crosslinked proteinaceous material and

b. 0.001-50 wt.-% of other active ingredients selected from the following group: pesticides, fertilisers, bioregulating additives, additives for increasing the fertiliser efficiency, plant productivity, growth and nutrient accumulation and adjuvants or any combination thereof.

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c) bioregulators of natural or synthetic origin which are either hormones or interfere in hormone metabolism and do not influence plant nutrition

d) bioregulators which interfere with plant growth by diverse, mostly unknown mechanisms, which may be related for instance to enhanced nutrient uptake

e) adjuvants which provide certain physical properties to the formulation, to the treatment appearance and properties, to the seeds or to the soil or aerial environment.

[0006] A seed treatment compositions typical for the current state-of-the-art is described in WO 98/57543 (page 6, by Novartis) to be a suspension concentrate containing 40% active ingredients (category a), 10% propylene glycol (category e), 6% of nonylphenol polyethylene glycol ether (category e), 10% sodium lignosulfate (category e), 1 % carboxymethylcellulose (category e), 1 % silicone oil (category e), and 32% water (continuous phase).

[0007] Another example for a fungicide seed treatment composition typical for the current state-of-the-art is described by U.Simmen et al. in Soil Biol.Biochem., Vol 30, No.4, 517-522, 1998 (page 518) where a wettable powder of cyproconazole (category a) is just mixed with polyvinylpyrrolidone (category e) and shaken in a rotating machine.

[0008] Another example for an insecticide seed treatment composition typical for the current state-of-the-art is described by P.J. Mulqueen et al. in Pestic.Sci., 1990, 29, 541-465 (page 463). It contains a non-renewable surfactant/latex composition for oil seed rape treatment.

[0009] Another example for a seed treatment composition typical for the current state-of-the-art is described in DE 4417555 (Bayer AG) where water-soluble polysaccharides, in particular gel-forming carraageenans were used.

[0010] Another example for a seed treatment composition typical for the current state-of-the-art is described in EP 0539332 (Sandoz LTD.) where active carbon, kaolin clay and a vinylacetate-ethylene copolymer were used to prepare seed dressing formulations.

[0011] A few cases are known where proteins or polyamino acids were used as additives in seed treatment compositions like casein (category e) and rhizobia bacteria (category b) (US 4,149,869, Coated Seed Ltd.).

[0012] James M.Scott (Advances in Agronomy, Vol. 42, 1989, page 51) described the use of water-soluble gelatine and casein (category e) with adhesive properties to provide a better environment for the survival of rhizobia (category b) following seed inoculation, and alternatively methyl cellulose and gum arabic (category e) could be used here.

[0013] Another example for a seed treatment composition containing gelatine is provided with WO 97/36471 (Monsanto Company). In this application food-grade gelatine was used as an additive to prepare seed coatings. However, no means are provided to prepare a water-insoluble, film-forming protein matrix (see comparison example).

[0014] The polyaspartates described in WO 98/30100 (page 5) which are polyamino acids and thus may be considered as proteins in a broader sense, are crosslinked to an amount limited to the extent that the water-solubility of the crosslinked homogeneous polyaspartic acid is not materially affected.

Description of the invention

[0015] Surprisingly it has been found that seed treatment and coating formulations prepared from crosslinked proteins provide an efficient plant growth promoting composition and a controlled delivery matrix for pesticides, micronutrients, bioregulators or combinations thereof.

[0016] The present invention relates to an aqueous film forming seed treatment composition comprising

- a. 5-50 wt.-%, preferably 5-25 wt% of a film forming crosslinked proteinaceous material and
- b. 0.001-50 wt.-%, preferably 0.1-40 wt% of other active ingredients selected from the following group: pesticides, fertilisers, bioregulating additives, additives for increasing the fertiliser efficiency, plant productivity, growth and nutrient accumulation and adjuvants or any combination thereof. The present invention further relates to a method for preparing said seed treatment composition.

[0017] Neither of the known seed treatment compositions hitherto described provides a crosslinked, water-resistant film-forming protein matrix covering the seed surface according to the present invention. In particular, neither of such known compositions contains the appropriate crosslinking agents to provide the required water-resistant, film-forming protein matrix surface according to the present invention. Very surprisingly, the said seed treatment and coating formulations provides enhanced seedling vigour and plant growth. Such enhancements were not to be expected from the film forming treatment composition alone. Furthermore, the compositions are useful to entrap pesticides and other adjuvants to provide control and prevention of disease infestation on seed and seedlings to further enhance the seedling vigour and crop yields.

[0018] The invented composition is easily and cheaply available from renewable protein resources by efficient crosslinking of the proteins and by addition of certain auxiliary additives. The resulting dispersions are then mixed with the respective components that belong to either of the above mentioned five categories a)-e) onto the seeds by using

tional groups present in proteins. The preferred crosslinking or curing agents are glyoxal, glutaraldehyde, polyisocyanates, bis(meth)acrylates such as N,N-ethylenebis(meth)acrylamide, carbodiimides, MF- or UF-resins and (poly) epoxides and polyaziridines, mostly preferred are glyoxal, polyisocyanates, polyepoxides and polyaziridines, and particularly preferred are the polyepoxides. Examples of polyisocyanate crosslinkers include the TDI types Basonat PLR 8525® (BASF, Ludwigshafen, Germany), Desmodur L® (Bayer, Leverkusen, Germany), Polurene AD75® (Sapici, Carronno Pertusella VA, Italy), Tolunate HDB® (Rhône-Poulenc, Paris, France), HDI trimer type like Desmodur N 3300® (Bayer) or Basonat HI 100® (BASF), Beckocoat® (Hoechst, Frankfurt, Germany) and other commercial polyisocyanates which are usually mixtures of largely analogue compounds. The carbodiimides are usually the dehydrated urea compounds derived therefrom (Robert D. Athey in *Additives for water-borne coatings*, Part 7: Curatives, European Coatings Journal 11/1996, 569). The polyepoxide type crosslinkers are mainly derived from the O- and N-glycidyl-compounds and from glycidylesters. Typical examples for those include epoxy resins combined with di- or polyamines or polyamidoamines. Typical epoxy components include commercial products like Araldit® (Ciba, Basel, Switzerland), Beckopox® (Hoechst), D.E.R.® (DOW Chemical, USA), Epikote® (Shell, Netherlands), Epodil® (Anchor, Waterbury, Connecticut, USA), Eupox® (Witco, USA), Grilonit® (Ems-Chemie Hldg AG, Switzerland), Kelpoxy® (Reichhold, Triangle Park, North Carolina, USA), Polycup172®, Polycup1884®, Kymene®, Kycoat23® (Hercules, Wilmington, DE, U.S.A.) and Resox® (Synthopol Chemie, Buxtehude, Germany), to name only a few, which are based for instance on glycidylethers, esters, epichlorohydrin, butane-1,4-diol-diglycidylether, monoglycidylethers and epichlorohydrin polyamide condensates from dicarboxylic acids and polyalkylene polyamines. The di- or polyamine or polyamidoamine components in these systems are usually used in modified form, for instance either by the reaction of di- or polyamines (alkylene amines) with mono- or dimeric fatty acids to polyaminoamides, by further reaction of the polyamidoamides with epoxides, e.g. with epichlorohydrin, or by the reaction of epoxy resins with the amines in a determined stoichiometry. The properties of these cationic products can be adjusted over wide ranges via the amines, epoxides and carboxylic acids used, and potential crosslinking activity for instance may be generated via azetidinium moieties by self-arresting inherent crosslinking via dilution, pH or the nature of the amino groups involved. Typically used amine components include polyamidoamine Type 250 Genamid® (Clariant AG, Muttenz, Switzerland), PAA adducts, EDA adducts (ethylenediamine), DETA adducts (diethylenetriamine), TETA-adducts (triethylenetetramine). Most of these and other amine components are components of the two-pack EP coating systems, e.g. in Epilink® (Akzo, Arnhem, Netherlands), Polyamine® (Bayer), Araldit® (Ciba) and Beckopox H® (Hoechst), to name only a few.

[0026] A typical melamine-formaldehyde (MF) crosslinker resin for the preparation of a dispersion according to the invention is the water-dispersible resin UrecolSMV® (BASF, Leverkusen, Germany). Typical polyaziridine crosslinkers for the preparation of a dispersion according to the invention are the IONAC® type crosslinkers like PFAZ-322® (Sybron Chemicals, Birmingham, NJ, USA) or CX-100® (Zeneca, Waalwijk, Netherlands).

[0027] Typically, amounts of 0,1-25 wt.-% of crosslinking agents with respect to the dry protein weight are required. It may also be advantageous to use a combination of at least two different crosslinking agents, e.g. having specificity for different reactive groups, such as a (di)aldehyde to react with amino groups, a carbodiimide or a diamine to react with carboxyl groups, and a polyaziridine or polyepoxide to crosslink carboxy, amide, hydroxyl and amine groups in order to obtain improved overall results. The crosslinking systems used preferably are water-based and commercially available. The film forming properties, drying characteristics and rheology of the dispersions, and the appearance and mechanical properties and water resistance of the seed coatings/dressings are very much influenced by the choice and amount of the crosslinking agent(s). For example, glyoxal, which is one of the less preferred crosslinking agents, gives slightly yellow or even dark brown films with increasing amount of this reagent, whereas the polyaziridines and the particularly preferred polyepoxides give bright colourless films regardless of the amount of reagent used. Surprisingly, the preferred polyaziridines and the polyepoxides, if used separately or in combination with each other or with other crosslinkers, considerably enhance the water resistance of the films.

Component (2): Auxiliary additives

[0028] In order to obtain the dispersible protein in aqueous medium, surface-active compounds, e.g. (sodium) dodecyl sulphate, and/or chaotropic agents such as urea, guanidine or guanidinium salts, calcium chloride and the like are used. Acids and or bases are usually required to properly adjust the pH value during the preparation of the dispersions and of the final formulation of the dispersions. In general, the use of volatile organic acids such as acetic acid, formic acid and volatile bases like ammonia is preferred, because non-volatile reagents are remaining as salts and may impart the water resistant properties of protein films. Plasticisers are polyols such as ethylene glycol, propylene glycol, glycerol, di- and polyethylene glycols, di- and polypropylene glycols, 2-methyl-1,3-propanediol, sugar alcohols such as sorbitol, mannitol, xylitol, isosorbide etc., hydroxyl acids such as lactic acid, citric acid and gluconic acid, hydroxyl esters such as lactic and citric acid monoalkyl esters, sugars such as glucose, fructose, saccharose and xylose. The plasticisers are used in particular in amounts of about 5-50 wt.-% with respect to the dry protein weight, preferably in amounts of about 10-30 wt.-%, most preferably about 20 wt.-%.

auxins like indolylacetic acid or indolylacetyl aspartate, the flavonoids and isoflavanoids like formononetin or diosmetin, the phytoalexins like glyceolline, phytoalexin-inducing oligosaccharides like pectin, chitin, chitosan, polygalacturonic acid, oligogalacturonic acid, compounds like the gibberellins produced by rhizobial symbionts and endophytic microorganisms like *acetobacter diazotrophicus* or *herbaspirillum seropedicae* or the rhizobial inoculants producing such kind of compounds.

Component (6): Ingredients of the category d)

[0036] Examples for additives for increasing fertiliser efficiency, plant productivity, growth, and nutrient accumulation are the commercially available products Auxigrow® (Auxein Corp., Lansing, MI, USA) and Amisorb® (Donlar Corp., Chicago) or the so-called phytochelates described by A.M. Kinnersley in Plant Growth Regul. (1993), 12(3), 207-18, which are described to influence the availability for minimal amounts of certain metals (Zn, Fe, Cu, etc.) for optimal growth and productivity. Examples for the latter are polymers of L-lactic acid, L-lactoyllactic acid or the water-soluble polyaspartates.

Component (7): Ingredients of the category e)

[0037] A large variety of adjuvants are available and contained in commercial agrochemical formulations. An overview is provided by Chester L. Foy in Pestic. Sci., 1993, 38, 65-76 and e.g. in EP 0357559 (Ciba-Geigy AG) for seed treatment formulations. The compositions of the invention may contain the usual ingredients recommended for seed treatment formulations, in particular agents with wetting, dispersing and defoaming mode of action. Suitable surface-active compounds are non-ionic, cationic and/or anionic surfactants having good emulsifying, dispersing and wetting properties. These adjuvants for crop protection formulations are provided by the fine chemicals producers, e.g. by Clariant AG (Muttenz, Switzerland) the (fatty)alcohol alkylphenol ethoxylates, the polyarylphenol ethoxylates, dispersing phosphates, taurides or alcohol monosuccinates. The term "surfactants", also comprises mixtures of surfactants and natural or synthetic phospholipids of the cephatin and lecithin series, e.g. phosphatidyl-ethanolamine, phosphatidylserine, phosphatidylglycerol, lysolecithin sugar esters. A typical defoamer is Fluowet PL80B® (Clariant AG) and typical antifreeze compounds are glycols and polyethylene glycols. Further ingredients are solid or liquid substances ordinarily employed in formulation technology, e.g. natural or regenerated mineral, tackifiers, thickeners or binders. Solid carriers used are normally natural mineral fillers, such as calcite, talcum, kaolin, montmorillonite or highly dispersed silicic acid in order to improve the required physical properties. Other suitable additives are emulgating protein hydrolysates, e.g. as used in EP 0297426 (Bayer AG). The dyes conveniently taken for seed treatment compositions, either water-insoluble or water-soluble dyes if required to distinguish coated from uncoated seeds may be used. Examples include Colanyl Red® (Clariant AG, Muttenz), Rhodamin B, white pigment (titanium dioxide) or Luconyl® (BASF AG). Such and other additives and aids are known to those skilled in the art. Altogether they may be used to ensure that the formulation disperses well, does not settle or freeze and differentiates the seeds from untreated seeds. Other ingredients comprised by this category are special additives which are known to enhance seedling vigour in particular in combination with certain pesticides, e.g. fungicides in combination with 3',4',5', 6'-tetrachloro-2,4,5,7-tetraiodofluoresceine (EP 0297 426, Bayer AG).

[0038] The ingredients of the seed treatment formulation are applied to the seeds in a combined amount effective, preferably synergistically effective, to increase seedling vigour and plant growth. An objective of the present invention is to provide means to reduce to a minimum the amount of either of the components 1-7. A preferred objective of the present invention is to provide means to reduce to a minimum the amount of the crop protection agents (component 3) to be used. Hereby several pesticides may be included to protect the plant from pests and plant diseases.

[0039] Furthermore the invention encompasses the process to apply the described seed treatment compositions. Usually the seed treatment composition containing the crosslinked film-forming protein and one or more of the components 3-7 are applied to the seeds by means of the appropriate device. Typical devices to be used for the seed treatment are agricultural seed treaters like the Plantector, Mist-O-matic, Rotostat or Centaur, which are described in detail by R.B. Maude in Pesticide Outlook (1990), 1 (4), 16-22. Likewise special semi-continuous or continuous coating units e.g. based on certain continuous flow systems may be used (Nickerson Seeds, UK). The compositions of the invention are obtained in a more or less viscous form, depending on the type and amounts of the components 1-7. Preferred compositions are directly sprayable dispersions, dilutable solutions or dilute emulsions to be applied onto the seeds by the standard commercial seed treatment machines. As with the nature of these components, the methods of application, such as coating by spraying, atomising, dusting, scattering or pouring, are chosen in accordance with the intended objectives and the prevailing circumstances.

[0040] Advantageous rates of application of the active ingredient mixture are generally from 50 g to 2 kg a.i./ha, especially from 100 g to 1000 g of the a.i./ha, more especially from 250 g to 700 g a.i./ha. In the case of the treatment of seed, the rates of application are from 0.1 g to 500 g, preferably from 1 g to 100 g, most preferably from 5 g to 50

[0046] The invention will be further described by reference to the following detailed examples. These examples are not meant to limit the scope of the invention that has been set forth in the foregoing description. It should be understood that many variations and modifications may be made while remaining within the scope of the invention.

5 Comparison example A:

[0047] In analogy to WO 97/36471 (Monsanto Company), two grams of gelatine, four grams of gypsum and 200 ml of hot water are thoroughly mixed. The cooled solution could not be used to prepare a stable film coating on solid surfaces, but the material was instantly washed off upon rinsing with some cold water.

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Example 1: Preparation of a proteinaceous film-forming seed treatment dispersion

[0048] Casein (50 g) was added to a mixture of 400 ml water and 12,5 ml 87% glycerol under continuous stirring. The pH was continuously adjusted to 9,0 using 25% ammonia. After all casein had dissolved, 20 g of soy protein isolate (Soya-L, Unisol L, Loders en Croklaan B.V., Wormerveer Holland, Netherlands) was slowly added to obtain a smooth dispersion. Then 3,5 ml of an aqueous glyoxal solution (40 wt-%, Clariant AG, Muttenz, Switzerland) and 3,5 ml of urea-formaldehyde resin (URSMV from BASF AG, Ludwigshafen, Germany) were added and the dispersion was held at 70°C for 30 minutes under stirring. After cooling to ambient temperature, 0,3 % of an antimicrobial agent (Proxel BZ®, Zeneca) was added. The viscosity of the dispersion obtained was about 480 cPs (measured with a Brookfield viscometer at 60 rpm).

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Example 2: Preparation of a proteinaceous film-forming seed treatment dispersion

[0049] Technical casein (750 g) was dissolved in 8 litres of water under continuous stirring at ambient temperature. The pH was continuously adjusted to 9,0 using 25% ammonia. After all casein had dissolved, 750 g of soy protein (Soya-L) was added. Then 300 ml of 87% glycerol and 75 g of guanidine hydrochloride were added. After complete dissolution of the guanidine, the dispersion was heated to 60°C and 300 ml of an aqueous glyoxal solution (40 wt-%, Clariant) was added. After 30 minutes reaction and cooling to ambient temperature, 0,3 % of an antimicrobial agent (Proxel BZ® Zeneca) was added.

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Example 3: Preparation of a proteinaceous film-forming seed treatment dispersion

[0050] 150 g of 90 mesh technical casein (Havero Hoogwegt) was slowly added to 850 ml of water containing 15 ml Glycerol (87%, Merck) and 7,5 g of urea (Merck) while stirring. During the addition of the casein (roughly 10 g per minute), the pH was adjusted to 8,0 using a 25% ammonia solution. After complete dispersion of the protein, 1,5 g of $\text{Ca}(\text{OH})_2$ was added very slowly under vigorous stirring. Then the dispersion was heated to 60°C while stirring. Then 7,5 ml of the polyaziridine crosslinker CX-100 (Zeneca, Waalwijk, Netherlands) were added and the dispersion was stirred for 30 min. After cooling, the dispersion has a viscosity of about 150-200 cP and a solids content of about 15%.

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Example 4: Preparation of a proteinaceous film-forming seed treatment dispersion

[0051] Technical casein (15 g, particle size 50 mesh, from Havero Hoogwegt BV, HB Gorinchem, Netherlands) was added to a mixture of 82 ml water (82 ml) and 3 ml 87% glycerol (Merck, Darmstadt, Germany) under continuous stirring. The pH was adjusted to 9,0 using 25% ammonia (total: 0,015 mol NH_3). After stirring for 20-30 minutes, all casein was dissolved and the solution was placed in a water bath at 70°C. The protein was crosslinked by the addition of 2,25 ml of an aqueous glyoxal solution (40 wt-%, Clariant AG, Muttenz, Switzerland) and further addition of 0,75 ml of methylbiphenyldiisocyanate (Merck, Germany). After cooling to ambient temperature, 0,3 ml of an antimicrobial agent (Proxel GXL®, Zeneca Specialities, Frankfurt, Germany) was added. The viscosity of the solution was about 300 cPs, as determined with a Brookfield viscosimeter.

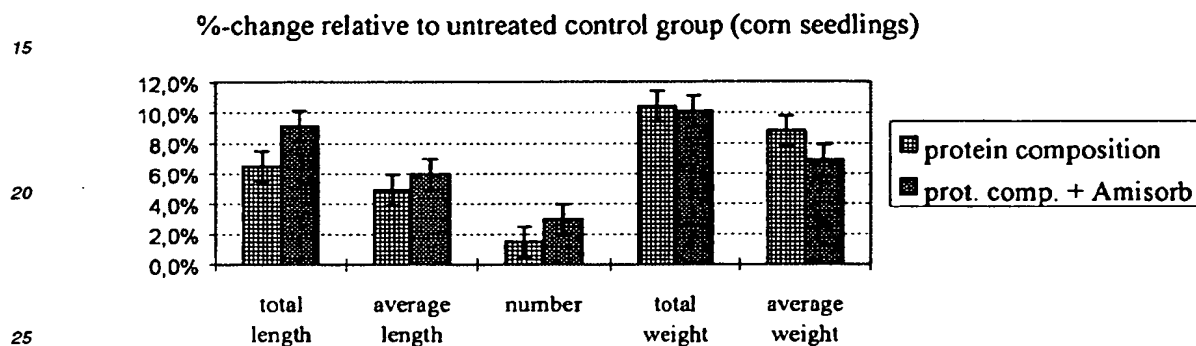
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Example 5: Preparation of a proteinaceous film-forming seed treatment dispersion

[0052] 150 g of 90 mesh technical casein (Havero Hoogwegt) was slowly added to 850 ml of water containing 15 ml glycerol (87%, Merck) and 7,5 g of urea (Merck) while stirring. The pH was adjusted to 9,0 with 25% ammonia solution. Then casein was added very slowly to avoid the formation of lumps (ca. 5-10 g per minute) under stirring and heating at 60°C. During the casein addition, the pH was kept constant at ca. 9,0 with the aqueous ammonia solution. Too much vigorous stirring would cause foaming which would lead to the formation of gas bubbles in the films. On the other hand, too little stirring would cause an inefficient formation of the desired protein dispersion. After complete dispersion of the

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centrate (ca. 50% a.i.) with the dispersion to obtain the content of 3.8% of Amisorb® by weight. An amount of 400 mg (500 µl) of each composition was used to treat each 100 g of corn seeds. In addition, the treatment compositions were mixed with Colanyl Red® (Clariant, Muttentz) to obtain a content of this dye, a category (e) component, of about 4.5 wt%. Plant growth was monitored in 3 groups of planting pots containing 136 plants in each group (control, treated with protein composition, treated with protein composition + Amisorb®), by using authentic, untreated, non-sterilised soil from the farmland located in Frankfurt/Höchst (Germany). All plants received artificial sun light for 8 hours per day and 12.3 ml of water once per day, corresponding to 450 mm/year rainfall, at a temperature range of about 22-27°C. After 14 days the plants were harvested and seedling numbers, length and weight were immediately determined. The results shown in the figure indicate - within reasonable limits of error - that the protein dispersion alone (left bars) provides an about equal benefit (improved seedling vigour parameters) as the bioregulator Amisorb® containing treatment composition.



Example 10: Preparation and testing of a seed treatment composition containing a fungicide

[0057] A film forming protein dispersion containing 20 wt-% relative to the protein content of the respective crosslinker solution, prepared analogously as described in example 5, was used. Three different seed treatment compositions were prepared and tested against a control group of untreated summer wheat, variety *Munk* in plant pots, each filled with ca. 1 kg untreated, non-sterilised soil from the farmland located in Frankfurt/Höchst (Germany). In detail, the treatment formulations were composed as follows:

a) Standard fungicide seed treatment formulation

- 100 g Wurzelschutz (Agrevo UK, Chesterford Park), contained 16.7 g fluquinconazole and 2.6 g other solids (mainly Colanyl Red® dye) in an aqueous dispersion;

b) Film-forming protein composition + fluquinconazole:

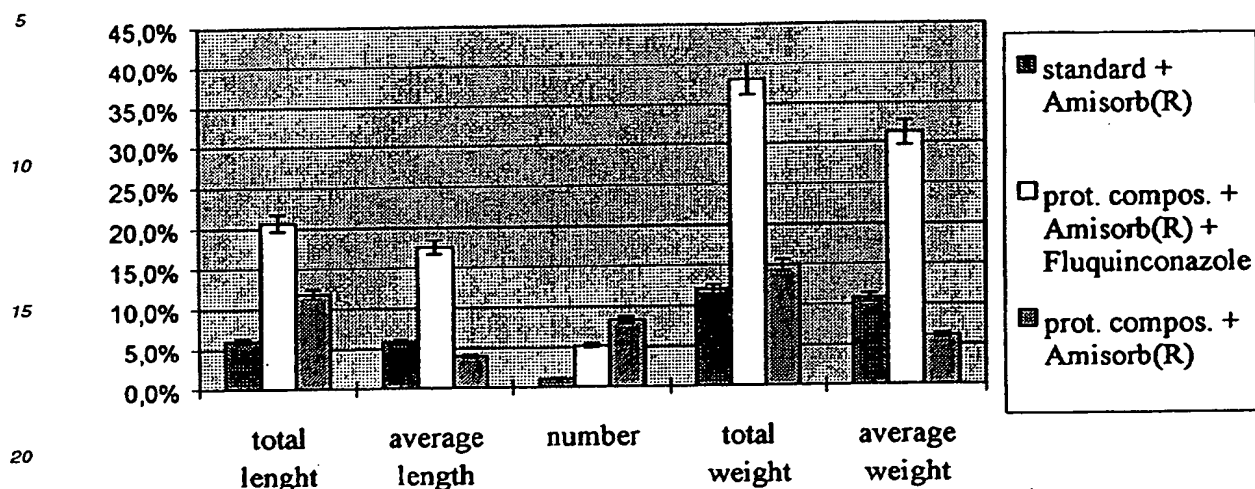
- 35.9 g Jockey Flex® Agrevo UK, Chesterf. Park), contained 15.7 g wet-milled fluquinc.;
- 4.6 g aqueous dispersion Colanyl Red® as (ca. 1.5 g of dye);
- 59.5 g of the protein dispersion.

c) Film-forming protein composition:

- 4.6 g aqueous dispersion Colanyl Red® as (ca. 1.5 g of dye);
- 59.5 g of the protein dispersion.
- 35.9 g water

[0058] An amount of 400 mg (500 µl) of each composition was used to treat each 100 g of wheat seeds. Each group was composed of 12 pots, each to be planted with 9 seeds, the fourth group being the untreated seeds. All plants received artificial sun light for 8 hours per day and 11.8 ml of water once per day, corresponding to 430 mm/year rainfall. After 12 days the plants were harvested and seedling numbers, length and weight were immediately determined. The results shown in the figure indicate - within the given limits of error - that the standard fungicide formulation and the protein composition without fungicide both had small effects on seedling vigour, whereas both in combination consid-

%-change relative to untreated control group (wheat seedlings)



Example 12: Preparation of an insecticide seed treatment composition

- [0061] The film forming protein dispersion of example 5 is thoroughly mixed either with 300 g of Fipronil® (Rhône-Poulenc) or with 320 g of Gaucho® (imidacloprid, Bayer AG) to provide the respective insecticide seed treatment compositions.

Example 13: Measurement of fungicide controlled release

- [0062] Two distinct coatings (300 µm wt application on glass panes) were prepared analogously as described in Example 7(B):

- a) only composed of the wet milled aqueous fluquinconazole dispersion from Agrevo (Chesterford Park, UK, sample-Nr. FD 32033).
 b) 3.2 g of the same dispersion as in a) mixed with 4.4 g of the respective protein dispersion and diluted with 2.4 ml water.

- [0063] After drying both glass panes were immersed in a pot containing 0.8 l of water (70 cm² immersed). Samples were taken from time to time (syringe filter 0.45 µm) and analysed by HPLC (222 nm). The coating not containing the protein dispersion immediately released the fungicide up to the saturation concentration (ca. 1.1 mg/l) whereas the protein-containing coating gave the release profile shown in the figure.

8. A seed treatment composition according to any of the preceding claims, wherein the bioregulator contained is Amisorb® and/or Auxigrow®.

9. A method for preparing an aqueous film forming seed treatment composition, by

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- a. dispersing 5-50 wt.-% of a film forming proteinaceous material in water,
- b. adjusting the pH-value to 5-9, adding auxiliary additives and adding 0,1-25wt.-% of a crosslinking agent, relative to the proteinaceous material, and
- c. allowing reaction between said proteinaceous material and a crosslinking agent
- 10 d. optionally adding about 1-40 wt.%, of a pesticide, preferably a fungicide or insecticide
- e. optionally adding about 0.1-10 wt.%, of a fertiliser,
- f. optionally adding about 0.001-5 wt% of a bioregulating additive
- g. optionally adding about 0.1-15 wt% of an additive increasing the fertiliser efficiency, plant productivity, growth and/or nutrient accumulation,
- 15 h. optionally adding 0,1-15 wt.% of an adjuvant,

wherein the chronological order of the steps a-h may be modified if this is required because of better mixing of the components.

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10. A method according to claim 9, wherein in step g 1-5 wt % of a nutrient uptake enhancer, in particular about 1-5 wt % of Amisorb™ or Auxigrow™ are added.

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11. A method according to claim 9, wherein a crosslinking agent selected from formaldehyde; glyoxal; glutaraldehyde; diisocyanate; a (poly)isocyanate; a bis(meth)acrylate, preferably N,N-ethylenebis(meth)acrylamide; a (poly)aziridine; a carbodiimide; a resin, preferably melamine-formaldehyde (MF), urea-formaldehyde (UF), benzoguanidine-formaldehyde; a diglycidyl ether, a glycidyl ester; a polyvalent cation, preferably calcium or zinc; an acetoacetate or a (poly)epoxide, preferably a polyaziridine or a polyepoxide, most preferably an epichlorohydrin-modified polyamine, epichlorohydrin-modified polyamide is employed.

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12. A method for applying a seed treatment composition according to any of the preceding claims to seeds by spraying, dipping or brushing in a seed treatment machine.

13. Seed treated by using a seed treatment composition according to the claims 1-8.

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14. Seed according to claim 14, wherein said seed are selected from cereals like wheat, barley, rye, oats, rice or sorghum, sugar beet or fodder beet, stone fruits or soft fruits like apples, pears, plums, peaches, almonds, cherries, strawberries, raspberries or blackberries, leguminous plants like beans, lentils, peas, soybeans, oil plants like rape, mustard, poppy, olives, sunflowers, coconut, castor oil plants or cocoa beans, cucumbers, melons, fibre plants like cotton, flax, hemp or jute, citrus fruits like oranges, lemons, grapefruits or mandarins, or vegetables like spinach, lettuce, asparagus, cabbages, carrots, onions, tomatoes, potatoes, paprika, or lauraceae like avocados, cinnamon or camphor, ornamental plants like flowers, shrubs, broad-leaved trees and evergreens, such as conifers, or other plants such as maize, tobacco, nuts, coffee, sugar cane, tea, vines, hops, bananas and natural rubber plants.

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 10 5217

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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02-08-1999

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